Washington State Department of Transportation

Tebuthiuron

Roadside Vegetation Management Herbicide Fact Sheet

This fact sheet was developed by Oregon State University and Intertox, Inc. to assist interested parties in understanding the risks associated with pesticide use in Washington State Department of Transportation's (WSDOT) Integrated Vegetation Management program.

Introduction

Tebuthiuron is a substituted urea herbicide used for control of broadleaf and woody weeds, grasses and brush. Tebuthiuron inhibits photosynthesis in plants. Tebuthiuron is the only active ingredient (80%) in the herbicide **Spike 80DF**. According to the product label, Spike 80DF also contains 20% other ingredients (unspecified). The Washington State Department of Transportation (WSDOT) uses Spike 80DF for total vegetation control. Tebuthiuron also has agricultural and urban uses.

WSDOT assessed the potential risks to human, wildlife, and aquatic animals exposed to tebuthiuron in their Integrated Vegetation Management (IVM) program. Evaluating potential risks takes into account both the toxicity of a pesticide and the characteristics of possible exposure.

Laboratory Testing: Before pesticides are registered by the U.S. Environmental Protection Agency (EPA), they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed doses high enough to cause toxic effects. These tests help scientists determine how chemicals might affect humans, domestic animals, or wildlife in cases of overexposure. Pesticide products used according to label directions are unlikely to cause toxic effects. The amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

WSDOT Application Rates and Use Patterns on Highway Rights-of-Way

Spike 80DF is applied broadcast at 3 to 5 pounds of product—or a maximum of about 4 pounds of the active ingredient tebuthiuron—per acre. This product is used in maintenance of a bare ground strip at the edge of pavement. Applicators use truck-mounted booms placed 18" above the ground to make applications of Spike 80DF in the spring or fall. WSDOT workers applied an average of 500 pounds of tebuthiuron per year, all on the east side of the state during 2004 and 2005.

Human Health Effects

The U.S. Environmental Protection Agency (EPA) classifies Spike 80DF as category III (Low Toxicity) with a signal word of CAUTION because it causes eye irritation and is harmful if inhaled, swallowed, or absorbed

Toxicity Category and Signal Word

	High Toxicity (*Danger*)	Moderate Toxicity (*Warning*)	Low Toxicity (*Caution*)	Very Low Toxicity (*Caution*)
Oral LD50	Less than 50 mg/kg	50-500 mg/kg	500-5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200-2000 mg/kg	2000-5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05-0.5 mg/l	0.5-2.0 mg/l	Greater than 2.0 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible in 7 days	Minimal effects, gone in 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

Note: Highlighted categories specify the range for tebuthiuron cited in this fact sheet.

through the skin (see "Toxicity Category and Signal Word" table).

Acute toxicity: Tebuthiuron has low (mice) to moderate (rats) toxicity if individuals accidentally swallow residues, and very low toxicity if it is inhaled or gets on the skin. In rabbits, there is slight irritation when tebuthiuron is applied to eyes and no irritation when applied to skin. Tebuthiuron did not cause skin sensitization in guinea pigs.

Chronic toxicity: Dogs fed tebuthiuron for 1 year had a variety of effects from the highest (moderate) dose, including anorexia, diarrhea, blood chemistry changes, and increased liver, kidney, and thyroid weights. In 2-year feeding studies in rats and mice, rats experienced a reduction in weight gain and an increase in kidney weight at moderate doses and no treatment-related effects were seen in mice, even at a high dose.

Reproductive effects: In a study of rats exposed to tebuthiuron during pregnancy, mothers had reductions in body weight and food consumption at the highest (moderate) dose. No developmental effects occurred. Rabbits given tebuthiuron during pregnancy had an increase in the number of fetuses per litter, but a decrease in the individual fetal weight. In a 3-generation reproductive rat study, a decrease in body weight in the first generation pups was noted at both doses (moderate) tested.

Carcinogenic effects: In 2-year feeding studies in rats and mice, no evidence of carcinogenicity was observed.
Fate in humans and animals: Rats, mice, rabbits, and dogs rapidly excrete tebuthiuron metabolites primarily in urine. Tebuthiuron does not bioaccumulate (build up) in mammals.

Wildlife and Aquatic Effects

Effects on mammals: Tebuthiuron is slightly to moderately toxic to small mammals based on acute toxicity studies. An acute oral LD50 value of 388 mg/kg has been reported for rats. Elsewhere, reported oral LD50s were 644 mg/kg in rats, 579 mg/kg in mice, and 286 mg/kg in rabbits. Via the dermal route, tebuthiuron toxicity ranges from practically non-toxic to moderately toxic based on an LD50 >5,000 mg/kg reported in rats and an LD50 of >200 mg/kg in rabbits.

Effects on birds: Tebuthiuron is practically non-toxic to birds based on an LD50 >2,000 mg/kg for mallard ducks exposed to 98% tebuthiuron in an acute oral exposure study. In subacute oral exposure studies, LD50 levels were >5,000 ppm for quail and mallard ducks exposed to 99.1% tebuthiuron.

Effects on fish: Tebuthiuron is practically non-toxic to fish based on 96-hour acute toxicity tests evaluated by U.S. EPA. Reported LC50 values for technical grade Tebuthiuron (98%) were 143 mg/L and 106 mg/L for rainbow trout and bluegill sunfish, respectively. In studies using formulated product (both 80% and 20%), LC50 values for fathead minnow were >180 mg/L. Acute LD50 ranges of 87 to 144 mg/L for rainbow trout and 87 to 112 mg/L for bluegill sunfish were reported elsewhere.

Effects on aquatic insects: Tebuthiuron is considered practically non-toxic to

LD50/LC50: Acute toxicity is commonly measured by the lethal dose (LD) or lethal concentration (LC) that causes death in 50 percent of treated laboratory animals. LD50 indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). LC50 is the concentration of a chemical per volume of air or water and is expressed as milligrams per liter (mg/L). Chemicals are highly toxic when the LD50 or LC50 value is small and practically nontoxic when the value is large. However, the LD50 and LC50 do not reflect potential health effects such as cancer, birth defects, or reproductive toxicity that may occur at levels of exposure below those that cause death.

Wildlife Toxicity Category

Risk Category	Mammals	Birds	Fish or Aquatic Insects
	Acute Oral or Dermal LD_{50} (mg/kg)	Acute Oral LD_{50} (mg/kg)	Acute LC_{50} (mg/L)
Practically nontoxic	>2,000	>2,000	>100
Slightly toxic	501-2,000	501-2,000	>10-100
Moderately toxic	51-500	51-500	>1-10
Highly toxic	10-50	10-50	0.1-1
Very highly toxic	<10	<10	<0.1

Highlighted categories specify the range for tebuthiuron cited in this fact sheet. The toxicity of tebuthiuron to wildlife receptors varies by species.

aquatic invertebrates based on an LC50 of 297 mg/L reported in the water flea *Daphnia magna* exposed to 99.2% active ingredient. In marine/estuarine organisms, LC50 values were >180 but <320 mg/L for Eastern oyster and 62 mg/L for pink shrimp.

Half-life is the time required for half of the compound to degrade.

1 half-life = 50% degraded
2 half-lives = 75% degraded
3 half-lives = 88% degraded
4 half-lives = 94% degraded
5 half-lives = 97% degraded

Remember: the amount of a chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

Environmental Fate

A typical half-life for tebuthiuron in soils is 360 days (see "Half-life" text box). Microbes and sunlight break down tebuthiuron in the environment. Tebuthiuron's potential to leach to groundwater is high; surface runoff potential is high, and potential for loss on eroded soil is intermediate. Tebuthiuron has moderate volatility and the potential for loss to the atmosphere is moderate. Tebuthiuron does not bioconcentrate (build up) through the food chain. Tebuthiuron is adsorbed through the roots and is translocated (moved throughout) to other plant parts.

Human Cancer/Non-cancer Risk Classification: Scientists estimate non-cancer health risks by generating a hazard quotient (HQ). This number is the exposure divided by the toxicity. When the HQ is less than 1, exposures are unlikely to cause any adverse health effects. When the HQ is greater than 1, the potential for non-cancer health effects should be considered. Risk assessments for chemicals that cause cancer (carcinogens) estimate the probability of an individual developing cancer over a lifetime. Cancer risks estimated in this way are very conservative, and actual cancer risks are likely to be much lower. Cancer risk estimates of less than 1 in 100,000 are within the range considered negligible by most regulatory

Human Health Risk Assessment

WSDOT evaluated several human exposure scenarios, including workers applying herbicides and the public (adults and children) picking and eating drift-contaminated berries, eating drift-contaminated garden vegetables, and walking through sprayed vegetation. For each exposure scenario, WSDOT evaluated conditions of average exposure and extremely conservative conditions of maximum exposure (see "Human Cancer/Non-cancer Risk Classification" text box and "Human Risk Classification for Average Exposure Scenarios" table).

Tebuthiuron is expected to pose negligible potential risks of adverse non-cancer effects to WSDOT workers and the public under conditions of average exposure. All hazard quotients are below 1. Under conditions of maximum exposure, Tebuthiuron poses a low potential risk of adverse non-cancer effects to workers engaged in broadcast hydraulic spray operations, adults and children ingesting drift-contaminated garden vegetables, and children coming into dermal contact with drift-contaminated berries and directly sprayed vegetation. The estimated potential risks are negligible in all other exposure scenarios.

Human Risk Classifications for Average Exposure Scenarios

Hazard Quotient (Non-cancer Risk)	Cancer Risk	Potential Risks and Management Priority
Less than 1	Less than 1 in 100,000	**Negligible**
Between 1 and 10	Between 1 in 10,000 and 1 in 100,000	**Low**
Between 10 and 100	Between 4 in 1,000 and 1 in 10,000	**Moderate**
Greater than 100	Greater than 4 in 1,000	**High**

Note: Highlighted categories specify the range of potential risk for specific exposure scenarios involving tebuthiuron.

Wildlife Risk Assessment

Wildlife risk assessment considers herbicide behavior in the environment and routes of exposure. Indirect exposure to mammals and birds can occur when they eat contaminated prey or vegetation. Direct exposure can occur when mammals and birds contact herbicide residues with their skin or eyes or when they inhale vapors or particulates. WSDOT's current application rates and use patterns for tebuthiuron are expected to

pose a low to moderate risk to mammals. The estimated dietary exposures to rats, mice, and meadow vole based on maximum label application rates would be 120, 13, and 18-fold lower, respectively, than the acute dietary LD50 for tebuthiuron. These exposures result in estimated risks from tebuthiuron that are considered low to rats but moderate to mice and meadow. The estimated dietary exposures of tebuthiuron to quail, marsh wren, and American robin from WSDOT's current application practices would be 380, 42, and 33-fold lower, respectively, than the acute dietary LD50 for bobwhite quail. The risk from tebuthiuron exposure is considered insignificant for quail and low for wren and robin.

Aquatic Risk Assessment

WSDOT takes extra precautions applying herbicides near open water, wetlands, and wellhead protection zones. However, contamination may result from application drift, rainfall runoff, or residue leaching through the soil into groundwater. Fish and aquatic insect exposure to tebuthiuron occurs primarily through direct contact with contaminated surface waters and sediment. Tebuthiuron is persistent both in soil and aquatic environments, but it does not tend to bioaccumulate (build up) in aquatic organisms. The relative risks to fish based on application of tebuthiuron at levels established by WSDOT were slight in all physiographic provinces except for provinces 6 and 7, where the risk was considered low, primarily due to reduced road densities and rainfall in these provinces.

Additional Resources

- National Pesticide Information Center 1-800-858-PEST (7378) and http://npic.orst.edu
- Washington State Department of Transportation, Roadside Maintenance Branch 1-360-705-7865
- Washington Department of Agriculture, Pesticide Management Division 1-877-301-4555 (toll free)